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Planning Green Infrastructure: Provisions and Alteration in Prominent Cities of Nigeria

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Abstract: Green infrastructure provides physical aesthetics, healthier and quality environment for urban settlements globe. However, many urban centres in the third world countries are deprived the benefits of green infrastructure and subjected to unhealthy conditions that endanger human safety, land uses and the entire ecological system of both macro and micro environment due to poor planning and government policies. This research therefore, compared the effect of green infrastructure alteration on the physical environment of two major cities (Port Harcourt and Calabar) Nigeria. The study sampled 6 green zones and 250 residents for both cities under investigation while Duncan Multiple Comparism analysis (DMCA), mathematical percentage (MP) and Analysis of Variance (ANOVA) was adopted as the statistical analysis implements. The findings established that calabar benefits from green infrastructure that improves the city aesthetics and other aspect of the environment through proper physical planning and government policies than Port Harcourt city of Nigeria at ($P<0.05$). In furtherance, the study revealed that usage understanding, budget constraint, wrong cost benefit analysis, and poor environmental management and maintenance strategies were identified as the key determinants of naturally retained and planned green infrastructure alteration in both cities, and discovered that, the city of Calabar was built on smart and resilient development strategies than Port Harcourt metropolis of Nigeria. The study recommended that town planning authorities should be charge with the responsibilities of smart and resilient city building through green infrastructure development and avoidance of informal alteration of such infrastructure. Also, suggested the need for frequent acquisition of data on green infrastructure development and inclusion in all land use development.

Keyword: Green Infrastructure, Planning, Provision, Alteration, Prominent, Cities, Nigeria

I. Introduction

Globally, the greening of land uses, generation and regeneration of the entire urban environment through green infrastructure has been given much attention by the town planners, architects and allied professionals that regulate proposed and built environment to realize sustainability and physical development that targets smart and resilient cities growth (Ubani, Tobi and Amakeree 2003). In this trend, green infrastructure appears to be crucial in human settlement because its functions and provisions are necessary and supportive for quality, aesthetics and inhabitable environment. However, different class of cities in the third world countries are witnessing rapid alteration of green infrastructures, its spaces and undesired effects are experienced socially, economically and environmentally in urban, suburb and rural areas. The un-ruled or ugly incidents are gaining more prominence and the situation aggravated when the driving force of population pressure, urbanisation and economic transformation in the developing nation increased, and overwhelmed urban planning and its management processes by both the informalities and unplanned development. The phenomenon prevails predominantly in residential neighbourhood (medium and high income densities) and commercial land uses. However, town planning standard of practice have initiated mandatory greening of substantial percentage of proposed micro and macro (building plans and neighbourhood designs/plan seeking approval to realize sustainability, smart and resilient built environment. Regrettably, the problems of green infrastructure alterations seem to overwhelm development control unit of urban planning, and the unfortunate situation may not be unconnected with the failure in the formulation of physical policies and programs by policy makers for cities and alteration of green infrastructure and its sustainability.

Problems of Green Infrastructure Alteration in Developing Nations Environment

The attendant consequences for green infrastructural alteration in mega and metropolitan cities of the globe frustrate urban morphology and portray unhealthy conditions, poor aesthetics and other problems that degrade quality environment and sustainable development. However, the harmful effect of greens alteration destabilized scientific planning and physical development of all manners in prominent cities found in developing nations. In the same vain, the increase of industrial and commercial actions triggered the conversion of green sites to other land use activities and informality directed by the political class despite the harmful impact and negative changes on urban villages and the entire environment. The view of United Nations (1987) anchored on the alteration of green infrastructures and their purposes that in most cases, upsets the bionetwork in different directions and the refusal to vindicate climate change, clamour and mid-air pollution from survey and extraction actions. Moreover, urban communities developed outside greens are under the influence of chronic ailments and other ecological encounters originating from dispensation and merchandise emission, and the effect may threaten and resettle the entire urban community.

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This analysis therefore, compared Port Harcourt and calabar physical alteration of green infrastructure. Survey the adverse impacts on human, physical environment and variation of planned and retained greens in both cities. The outcome of the research will benefit decision makers, town planners, allied professions of built environment and research community by conveying pertinent strategies that deters green infrastructure alteration and management in both cities especial Port Harcourt. This will ultimately stimulates environmental sustainability, while pursuing the goal of green spaces development.

II. Literature Review

Sequel to the research works conducted for natural and scientific developed green infrastructure across the globe, Fedorov, Kuklina, Sizov, Soromotin Prihodko, Pechkin, Krasnenko, Lobanov and Esau (2021) considered historical viewpoint of urban green and blue spaces in a sub-Arctic urban area of Nadym in Russia through joint measureable data from satellite imagery and biometric examinations and descriptive data from meetings with critical investors and populaces. The result revealed that green areas were used less during summer stock, silent extremely valued, deep seas are charity and cherished additional than heater light ponds and season bleached intergalactic do no therapist but improve the urban community space. Again, Cable images showed predictable damage of green galaxy to urban structure and its solution by means of false plantings while small significance blue space reduced virtually three-times. According to Hao-Ting, Chih-Da, Jung-Der, Po-See Ying-Jan and Huey-Jen (2020) determined green interplanetary assemblies and schizophrenia occurrence in Taiwan The study held random sampling techniques and the result shown that none relationship exist between greatest green areas assemblies directories and schizophrenia occurrence which implies that conclusions planned that for green spaces and a superior unkind square environ and control density, (higher perimeter–area ratio, greater proximity, could decrease the jeopardy of schizophrenia. Jochem, Gerard, Bloemsmaab, Maciejm. Wijgaa, Brinka, Erik, and .Janssen (2018) shown that coldness to the adjoining park arrival was not related with overweight or outside physical action. The Links between adjacent green space and overweight or outside physical actions were highly non-linear. In respect of NDVI neighbouring greenness, the investigation discovered pointedly reduced odds of being overweight and enlarged odds for outside physical activity in the peak quintile associated to the lowest quintile. on the angle of TOP10NL green space environment, relationship were frequently non-important. The meeting of Word Health Organisation (2016) reported that, the road map interferences of green space available around urban communities may solve numerous communal health challenges connected to obesity, cardiovascular effects, mental health and well-being. As the awareness on the efficacy of the involvements in reality to health, comfort and fairness is incomplete. According to WHO reviewed report on previous investigation proved, the gathering of native situation studies and instances of Environmental Impact Assessment/Health Impact Assessment understandings, such professional meeting was held in respect of variation of green space intrusion methods and their connected influences on environmental circumstances, health standing, comfort and fairness. This report presents the discussion and conclusions on what intervention components have been found to be effective in maximizing the environmental, health and equity benefits derived from urban green spaces.

Marianne (2019) analysed humanity's recent encounters, climate variation and chronic sickness, in connection with co- welfares that green spaces supply to hominoid health and the entire surrounding. The author discovered that availability of green space minimized nervousness, obesity and cardiovascular disease. According to him, Green spaces brings healthy environment by minimizing flooding, advancement of air quality, cooling, canopy and tackle the indicators of many prolonged sickness and connected hazardous issues together with ecological and well-being effects of temperature variation. Wim, Jan and Marian, (2021) studied the role urban green spaces show on the course of social elimination and urban greening policies for ornamental social fairness meant for precise clusters that were omitted, especially aging individuals with dementia, people with mental problems within the vicinity of disadvantaged district. The authors also classify four serious issues outside the conceivable approaches and actions to encourage insertion. They pinpointed that instruments and treatises were challenged on the course of analysing inclusive promotion of the aged with dementia, group considered as on sound mind and population residing in the poor region. While successful addition approaches in these direction are built on arrangement at the middle of private performer's creativities and communal activities. The work concluded that both municipal and individual activities required good collaborate in a direction that make urban green space portion of attachment approaches.

Historical Development of Green Infrastructure and Implementation Possibilities

According to Richa, Lolita and Maya (2022), opinions were built on driven variety of ideas pertaining urban green infrastructure. They deemed it necessary that such development should anchored on Europe and broader context because green infrastructure has some pre-requisite for the 21st century strategies of protection and expansion of EU drew back to the replicas of model resurgence cities and urbanism ideas mainly of the 19th and 20th epoch. For the historical era, applied ideas destined urban landscapes a scheme, component of the atmosphere, as understood in green corridors, green belts, green wedges, green networks and concluded the insight of urban green components. Being a contemporary idea that urban green infrastructure used for advancement through developed roles, spreading occupations, possibilities and gauges emanating from past historical concept. Within that intellect, it upholds the societal protagonist of enhancing standard of living across the urban environment, and with the same time defining town texture and urban morphological significance. It enhances ecological standards and extends its scale to non-urban, local, regional and international backgrounds. Presently, green infrastructure shapes experts and scientific discussion, political approaches and practical strategies about greenery growth predominant the urban hemisphere.

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III. Method and Techniques

This analysis concentrated much on environmental observation, questionnaire administration, group discussion, and multiple-stage sampling techniques employed to arrive at the target respondents. The research considered and adopted 25 and 27 planning neighbourhoods of Port Harcourt and calabar metropolis recognise by national population commission (NPC, 1991). From the 52 planning districts of both cities, the study selected one (1) neighbourhood randomly from five classified neighbourhood. Thus, Nkpoluorogbu, Rumuoparali, Borikiri, ogbunabali and Nkpolo for Port Harcourt Towns and Etagbor, Esien Town, Etimedem, IBB Road and Tinapa zone for calabar and preceded by reconnaissance survey that determined the number of streets in every selected neighbourhood. However, 81 streets in Nkpoluorogbu and tinapa area, 51 in Etagbo and Rumuoparali, 63 Borikiri and Essien town, Ognunabali and Etimedem 43 and 35 at Nkpuolo and IBB Road. One out of every ten street was selected in each of the selected district of the two cities.

In continuance, another survey were conducted to determine the number of buildings in the identified streets of both cities; Reconnaissance survey revealed that there were 284, 310, 221, 475 and 373 buildings in Nkpoluorogbu and tinapa area, Etagbo and Rumuoparali, Borikiri and Essien town, Ognunabali and Etimedem and Nkpuolo and IBB Road respectively. Using systematic sampling method, every 5^{th} building was sampled. Thus, 120 buildings were sampled in Nkpoluorogbu and tinapa area, 105 in Etagbo and Rumuoparali,135 in Borikiri and Essien town, 155 in Etimedem and Ognunabali and 127 in Nkpolo and IBB road. A total of 636 household heads were sampled from the selected buildings and 615 representing 96%. In like manners, 308 copies of questionnaire were distributed in Port Harcourt and 307 copies in calabar representing 98.1 were returned for analysis. Issues addressed in the questionnaire included alteration of green infrastructure, green appearance of both cities and environmental problems associated with greens alteration in both cities. Duncan Multiple Comparism analysis (DMCA), mathematical percentage (MP) and Analysis of Variance (ANOVA) was used to determine physical greening and environmental aesthetics, alteration of green infrastructure and associated environmental problems

Table 1: Green Infrastructure Alteration Condition for Port Harcourt and Calabar Nigeria

S/N	Port Harcourt Towns	Calabar Towns	Selected Streets for both cities	selected Buildings for both cities	Sampled Buildings
1	Nkpoluorogbu	Tinapa Area	81	284	120
2	Rumuoparali	Etagbo	52	310	105
3	Borikiri	Essien Town	63	221	135
4	Ognunabali	Etimedem	43	475	155
5	Nkpolo	IBB Road	35	373	127
TOTAL			**274**	**1,663**	**636**

Environmental Survey 2023

IV. Result and Discussion

Physical Greening and Environmental Aesthetics for Prominent Cities of Nigeria

The comparative analysis conducted for greening and aesthetics values and quality of both cities in Nigeria through physical observation, planned and naturally retained greens through questionnaire, group discussion and environmental observations confirmed (ANOVA) as presented in table 2 shown that significant difference exist in greening and physical appearance of calabar and Port Harcourt city at 0.01 level [F – 10.583; significant at p =0.002}. The study had similarity with (2016) World Health Organisation report which insisted that, the only way to discover the efficiency of urban green spaces intrusions to improve strong urban settings is nothing but to assemble European specialists on green space and town planning to exchange ideas and practices about urban green space interferences This implies that town planning practice that ensure the implementation of various land use activities including green infrastructure development exist in calabar metropolis. But Port Harcourt city that beacon her poor planning experiences on the alteration and disregard of planned and naturally retained green infrastructure with adverse effect. Suggesting that the review of urban expansion policies, physical development standard and powers control mechanism to achieve urban green infrastructure was achieved in calaba than Harcourt metropolis.

Table 2: Aesthetics Analysis for Calabar and Port Harcourt Greening in Nigeria

Port Harcourt/ Calabar	Sum Square	Df	Mean Square	F	Sig.
Between group	227.146	1	237.146	10.583	002.
Within Group	1449.114	61	22.318		
Total	1586.188	62			

Environmental Survey 2023

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Determinants of Green Infrastructure Provisions and Alteration in Nigeria

The summarised analysis on determinants of greens alteration is detailed in table 3. However, the populations investigated identified five (5) major determinants of green infrastructure alteration in developing urban centres of the globe include usage understanding, budget constraint, wrong cost benefit analysis, and poor management and maintenance strategies. The identified factors were responsible for 100% determinants and alteration of green infrastructure in areas. The analysis related to United Nations comment on greens (1987) which attested that global community have been reacting to the certainty neglect and detrimental impact of urban green alteration in many parts of the cities including the capability of preventing the advantages obtainable from such land uses. The international standard further stressed that such complications could be eradicated through the practices of scientific greens, land use development, implementation and strategies that reduces chronic health. This implies that towns and villages including green infrastructure has continue to develop spontaneous or without physical planning guide in Port Harcourt city while calabar metropolis evident scientific planning and implementation of land use policies that sustained greens.

Table 3: Determinants of Green Infrastructure Alteration in Port Harcourt and Calabar

S/N	Constant/Predictors	Port Harcourt	Calabar	Coefficient
1	Understanding the usage	35%	45%	25%
2	budget constraint	65%	15%	25%
3	wrong cost benefit analysis	56%	24%	25%
4	poor management	60%	10%	10%
5	maintenance strategies	64%	10%	15%

Sources: survey 2023

Smart and Resilient Nature of Nigeria Prominent Cities and Green Infrastructure

The contrast tests held for smart and resilient nature of both Port Harcourt city and Calabar metropolis of Nigeria suggests that Calabar experience resilient and smarter environment appearance than Port Harcourt city. The compared analysis built on professional point of view and environmental clarifications as attested by the cities dweller was adopted as an input data through Duncan multiple comparison examination conducted. The result presented in table 2 showed that significant difference existe in the smarter and resilient nature of calabar and Port Harcourt prominent cities of Nigeria at 0.05 (2.8335 and 2.4629) alpha subset respectively. This implies that Port Harcourt just like many cities of the globe especially in sub-Saharan Africa experience much alteration of green infrastructure characterised by antagonistic effect of higher green infrastructure alteration, disregard, poor urban policy and non-equipment of physical development authorities that may demonstrate commitment for friendly environmental and climate change leverage. However, calabar urban just like many cities in advance countries demonstrate more priority on green infrastructure development, good urban policy, proper physical development and commitment for smarter and resilient settlement. Furthermore, urban development policies that enhance planned and naturally retained green infrastructure and mandatory approval of different physical plans encompassing greens are common and higher at calabar. This study gained support from Hanneke, Nina, Brigit, Ruth, Aline, Gabriel, Sahran, Sonia, Pablo, Monica, Fotis, Pania, ,Maria, Silvestre, Matluba, George and Ingrid (2019) who confirmed that generating good-strategic green spaces and inspiring human to harvest the advantages may convey three-way win by enhancing availability, attractive, healthy preserved green space with room for socialization, and areas people are safe, can upsurge the chances and inspiration of populace applying it every time

Table 4: Smart and Resilient Variation of Port Harcourt and Calabar Green Infrastructure

Metropolis	Number	Alpha Subset	Sig.
Port Harcourt	318	2.4629	1.000
Calabar	318	2.8335	1.000

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V. Conclusion

Enhancing greening, environmental aesthetics, smart and resilient environment in the 21st century, take account of neighbourhoods and scientific approaches of holistic urban planning, architectural design and sustainable development that considers green infrastructure. However, the alteration of green infrastructure is minimal in calabar but occur frequently in Port Harcourt through informal actions and poor environmental planning. Meanwhile, realizing sustainable aesthetics and quality environment in Port Harcourt requires warning and mechanism to abate alteration, conversion and exclusion of green infrastructure in various physical planning. This may be realising through the protection and proper management of the physical environment.

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Recommendations

To minimise the alteration of green infrastructure in Port Harcourt and sustain developed greens in calaba, the following solutions are proffered in this research

1. **Application of General Urban Greens**

   In both cities**,** the government charge with urban planning activities should be vigorously involved in greening. However, area coverage, poor instrument and limited land max, the ministry charge with urban development may be in difficulty to green various parts of the cities. This is why the third tier of government, and non-governmental organisations and individual green development practices should be actively integrated in term of initiatives, development and protection of green areas to avoid alteration. The third tear of government must ensure that greening embraces every nook and cranny of Port Harcourt and calabar urban and not just secluded to ascertain areas and parts of areas.

2. **Inclusion of non- Governmental Physiques in Green Development and Protection**

   Greens are very significant issues for the realisation of sustainable development in both cities. Novelties of greens will be significant for both cities due to their aesthetics, hazardous filtering, and quality health and environment contributions in urban centres. However, the global physiques such as world health organisation, UN habitat etc are seriously sponsoring urban green plan the whole world. And non-governmental organisations built for urban green development in these cities are expected to ease greens as their corporate social responsibility especially in the neighbourhoods of the cities. On this note, it is necessary to formulate schemes, drivers and spread risk planning for potential threats to greens in Port Harcourt and sustain green infrastructure that makes calaba city more beautiful through master plan, neighbourhood campaign and inclusion of greens in all land uses development. Diversification of green infrastructural plans and inclusion of urban agriculture will reducing chronic health challenges and environmental problems and enhance urban morphological aesthetics and food production.

3. **Discouragement of Green Alteration/ Building on Resilient and Smart Cities**

   There is need to discard the factors responsible for greens alteration but encourage scientific techniques of urban greens alteration and replanting to caution the effect of poor aesthetics and human health. Appropriate local green prevention measure should be utilized. Prevention and protection mechanism such neighbourhood taskforce on green spaces should be encouraged. Therefore, the government and ministry of urban development should be fully involved in the development and protection of urban greens. As a means of reducing the loss and challenges of urban greens, it is recommended that green development programmes in which the urban populace are involved should be encouraged. This could be achieved through the integration of such polices in residential housing design and development.

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